8.

8. DEVELOPMENT OF ALTERNATIVES

In this chapter, remediation alternatives retained after screening in Chapter 7 are further developed to allow detailed evaluation. Based upon the screening of alternatives in the preceding chapter, the following alternatives have been retained for detailed development and evaluation:

Alternative 1: No Action
Alternative 2: Institutional Controls and Monitoring
Alternative 4: Soil Cap
Alternative 5: Low-Permeability Soil Cap
Alternative 6: FML Cap
Alternative 7: FML/GCL Cap
Alternative 9: Excavation and Off-Site Disposal of All Waste and Contaminated Soil.

For simplicity, Alternative 9 is referenced henceforth as "Excavation and Disposal".

It is necessary to make a number of design assumptions to fully develop and evaluate each alternative. These design assumptions are representative of the technologies used in the alternatives. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design. In most cases, additional investigations would be necessary to allow final design. For example, additional soil sampling would be performed prior to excavation to better define the extent of soil contamination. Waste characterization would be required following excavation for potential treatment or disposal.

8.1 Common Elements

Several alternatives share common elements in their formulation. To avoid repetition, this section presents the descriptions of elements common to two or more alternatives. These common elements are then referenced in the descriptions of the alternatives.

8.1.1 Institutional Controls

All of the alternatives where contaminated material may remain on-site include institutional controls, with the exception of Alternative 1 (No Action). Alternative 9 (Excavation and Disposal) does not include institutional controls because no waste would remain on-site after completion of remediation. Institutional controls are a key component of the alternatives for maintaining long-term effectiveness.

Deed restrictions would be instituted to ensure that site use restrictions remain in force regardless of the property owner, and to notify any prospective purchasers of the presence of subsurface waste. Site use restrictions would prohibit using the site for any purpose incompatible with a waste disposal site. For capping alternatives, these restrictions would prohibit penetrating the cap and any site use that could damage the cap or significantly reduce its effectiveness. Warning signs would be used to provide notice of the presence of a waste site. Site use restrictions would remain in force indefinitely.

For Alternative 2 (only), fencing around the trench would be included to provide a physical barrier against trespass. Fencing is not needed for capping alternatives because the trench backfill would provide a very thick barrier against contact with any waste material, such that incidental trespass (which fencing is designed to prevent) or limited utilization of the site would not present a health risk.

Periodic site inspections and maintenance of a cap, fencing, signs, and any other physical components of the institutional controls would be included.

Groundwater use restrictions would be employed to prevent exposure to site groundwater. Thus, if site groundwater were to become affected by waste constituents, there would be no immediate exposure. Exposure could occur only following off-site migration. Routine, periodic monitoring would detect constituents of concern in groundwater were it to become affected prior to off-site migration.

Groundwater currently meets remediation goals. Therefore, no groundwater containment or treatment is currently necessary. In the event that groundwater were to become affected by waste constituents from the site, groundwater containment and/or treatment could be readily implemented. Alternate water supplies (e.g., bottled water) could be provided while appropriate action for groundwater cleanup was being implemented. Therefore, with this contingency available, institutional controls and monitoring address the possibility of future groundwater concerns.

8.1.2 Monitoring

Monitoring is included as part of all alternatives, except Alternative 1 (No Action). Separate monitoring programs will be used for the short term (during remedial action) and the long term (following completion of remediation). Detailed monitoring plans will be developed for the selected remedy during final design and presented in the Compliance Monitoring Plan for approval by Ecology.

8.1.2.1 Short-Term Monitoring

Short-term monitoring is conducted during remediation to ensure that there are no adverse effects from remediation activities, to provide quality control, and to confirm the attainment of cleanup standards and/or relevant performance criteria. Health and safety monitoring is also performed to ensure that site workers are not exposed to undue or unexpected risks.

Attainment of cleanup standards is applicable only for Alternative 9 (Excavation and Disposal) because the other alternatives use containment and monitoring rather than removal. Short-term monitoring for Alternative 9 would include confirmatory soil sampling and analysis to verify the attainment of cleanup standards in trench soil. Short-term monitoring for the other alternatives would primarily consist of construction quality assurance (CQA) to confirm attainment of construction specifications. CQA specifications would address acceptable materials for trench backfill, soil compaction, final grades, liner installation (i.e., for FML and GCL liners), and other aspects of the remedy that affect performance.

8.1.2.2 Long-Term Monitoring

Long-term, or confirmational, monitoring is conducted to 1) verify that the remedy performs as expected over time, and 2) allow timely maintenance of a cap and other physical components of the alternative. Periodic site inspections and surveys would be sufficient for determining maintenance needs and monitoring cap performance. Cap performance is also monitored by groundwater monitoring. No long-term monitoring would be required for Alternative 9, assuming all waste could be removed from the trench. Long-term monitoring would continue during the post-closure period, assumed for the purposes of the FS to last 20 years per WAC 173-304, and then cease.

Cap Monitoring. Cap monitoring would consist primarily of visual inspections for damage and subsidence. The cap would be periodically examined for the presence of off-sets, scarps, low-points, ponded water, odd changes in grade, excessive erosion, and the condition of the vegetative layer. For the first year, such inspections may be performed on a quarterly basis and would eventually be reduced to once a year until the end of the post-closure period. The cap monitoring program would essentially be identical for all cap alternatives.

Groundwater Monitoring. Groundwater monitoring would include periodic groundwater sampling and analysis at selected key locations throughout the site to confirm that concentrations of constituents of concern from waste disposal activities do not exceed acceptable limits. Site groundwater currently meets remediation goals, so the monitoring program will be designed for detection of release of waste constituents into site groundwater, should it occur. Because groundwater from the trench is channeled by the trench sidewalls with vertically sloping rock strata, providing some natural containment, monitoring where the groundwater exits the trench (i.e., the north and south portals) is sufficient to detect any release that could occur. As discussed in Section 3.6, the primary pathway of constituents of concern potentially exiting the mine is to the northeast toward the Cedar River. Therefore, groundwater monitoring would focus on detecting potential releases at the northern end (i.e., LMW-2 at portal #2). However, to detect the highly unlikely occurrence of constituent release to the south, monitoring may be provided there also (i.e., LMW-3 at portal #3). In the event that a release is detected, then the potential migration of affected groundwater would be evaluated and additional wells sampled and analyzed as necessary to monitor movement of the affected groundwater.

If a release were to occur, it would be more likely during or immediately after when the trench is being filled. Based upon the reported handling of drums during placement in the trench, and given the length of time since placement, most drums are probably already breached. The additional load of the backfill, however, may further collapse the drums, increasing the potential for a release. Affected soil could also be compressed, potentially (but not probably) leading to migration of constituents of concern. After trench consolidation, the stresses would have equilibrated and the potential for a release would be much less. Considering that the travel time of a release, were it to occur, could be as low as a few days, frequent monitoring is appropriate during backfill placement. Therefore, the sampling program would have two components: 1) near-term, frequent monitoring (which could be considered short-term monitoring) during trench backfilling; and 2) confirmational monitoring for the remainder of the 20-year post-closure care period.

Details of the groundwater monitoring will be developed during final design and presented in the Compliance Monitoring Plan. It is anticipated that the program will include the following elements:

- Monitoring would be performed using 2 monitoring wells, one each at the north and south portals (e.g., existing wells LMW-2 and LMW-3). Because the hydraulic conductivity is much greater longitudinally in the mine than laterally (see Section 3.6.3), monitoring these two locations would be sufficient to detect release of constituents of concern. If constituents were detected at levels of concern in these 2 monitoring wells, then additional wells could be sampled and analyzed to determine the extent of constituent migration. However, if constituents of concern are not detected at the north or south portals, then it is safe to assume that no other wells are affected by mine constituents of concern, and monitoring additional wells would simply be wasted effort.

- Frequent monitoring of these 2 wells would be performed during trench backfill and cap construction, which is estimated to take approximately 8 weeks. Samples would be obtained two times per week from these wells and analyzed for pH, specific conductance (as an indicator for metals and other inorganic compounds), and a screening-level analysis for organic compounds. An organic compound screening analysis would be selected capable of detecting a wide range of potential organic compounds. One suitable analysis would be Method 418.1 (which detects any carbon-hydrogen bond by infrared spectrophotometry) modified to report detection of any organic compound. Any detections or anomalies in the screening analyses would be subject to more detailed laboratory analysis. For confirmation, samples would be analyzed every other week for pH, key metals, and TOC.

- If an acute release is to occur, it is most likely to occur when the load is imposed (i.e., during trench backfill). However, for added safety, near-term monitoring would continue for an additional 4 weeks. This monitoring would consist of weekly sampling and analysis for pH, key metals, and TOC.

- Long-term (confirmational) monitoring would start quarterly, then decrease to annual as warranted by monitoring results. For this FS, it was assumed that the monitoring frequency would be quarterly for the first year, semi-annual for the next four years, and annual thereafter until completion of the 20-year post-closure period.

- Long-term monitoring would consist of annual and screening-level monitoring. Annual monitoring would provide comprehensive monitoring for specific constituents of potential concern, and would consist of full GC/MS analysis (volatiles, semivolatiles, and pesticides/PCBs) and key metals. Selected general water quality parameters (pH, specific conductance, TSS, and TDS) would also be included. Screening-level monitoring would be conducted when the monitoring is more frequent than annual (i.e., quarterly or semiannually), and would use indicator parameters. More in-depth analysis would then be performed if screening monitoring were to indicate that constituents could be present at levels of concern.

8.1.3 Trench Backfill

All of the capping alternatives include first filling the trench to provide a surface for cap construction. The backfill would also provide a thick physical barrier that would greatly enhance the effectiveness and reliability of the cap.

The trench also presents physical hazards which are the result of coal mining and not the result of waste disposal activities. Remediation at this site is limited to environmental effects of waste disposal activities. Therefore, removal of physical trench hazards is not a remedial action goal at this site (see Section 7.2.3.1 discussion). The trench would not require backfilling to current grade, so long as good stormwater drainage is provided (see Section 8.1.4). However, backfilling the trench as part of environmental remediation would result in incidental reduction of physical hazards. Only the areas to be capped (Figures 8-1 and 8-2; see Section 8.1.5) would be filled.

Outside the trench, the ground surface would be cleared and grubbed to remove organic debris. The topsoil would be stockpiled for use in the vegetative cover layer of the cap. In the trenches, trees and large brush would be removed to prevent vertical transmissive zones through the backfill, when the trees eventually decay. This would also prevent excessive settlement of the backfill, which might occur if backfill is placed on a “mat” of small trees. Because of safety concerns, small equipment inside the excavation or cranes outside the excavation would be appropriate.

Suitable fill material would include any inert material capable of bearing overlying loads without excessive settlement. The most economical local source of suitable fill would be used; the selection of the source(s) of trench backfill will be made during final design. For purposes of this FS, it is assumed that backfill would consist primarily of soil and rock from areas adjacent to the trench area to be capped. Additional material from the south area of the site would probably also be needed. On this basis, the trench fill is assumed to consist of a silty sand and gravel (till), sand and gravel (outwash), and/or excavated rock fill (which would likely breakup into a silty granular fill).

Filling the trench will induce settlements which must be accounted for in the design and installation of a cap. The existing materials in the trench are expected to be moderately compressible due to their loose nature and inclusion of construction debris and organic materials. Backfilling is expected to induce compression of these materials which will result in surface settlement on the order of 6 inches to a foot. Settlement of the new fill depends on the type of fill used and the method of placement. End-dumped fill of poor quality could settle on the order of 2 to 4 feet. A better quality fill with moderate compaction effort might settle on the order of 3 to 6 inches.

About 75 percent of the settlement would be expected to occur within a few weeks of fill placement provided the cover restricts future infiltration of water. The remainder of the settlement will continue gradually for many years at a decreasing rate. The trench could be over-filled by about 4 feet for a period of about one month to both add a small "surcharge" and to allow time for most of the settlement to occur. After the surcharge period, the backfill would be graded for cap placement.

A conceptual cross section of the backfilled trench is shown on Figure 7-1. The lower zone of the trench backfill would not be compacted because of the unacceptably high safety risk of sudden trench collapse caused by heavy vibrating equipment. The upper portion of the backfill would be compacted to reduce the settlement of the cap foundation. Once the trench has been filled, the backfill would be allowed to settle and consolidate. Final grading and cap construction should be delayed until after the surcharge period. A period of at least one month should be sufficient for this purpose.

There will be a tendency for a sharp differential settlement to occur at the location of the trench sidewalls. In addition, use of poor quality and variable fills can result in differential settlements away from the trench sidewalls. To limit abrupt differential settlement, over-excavation and backfill would be considered at the top of the sidewalls to create a transition zone, as shown on Figure 7-1.

The concern over potential settlement is greatest where a synthetic liner is included in the cap design (Alternatives 6 and 7) because liner failure (i.e., tearing under the stress of settlement) would be difficult and expensive to repair. Soil caps (Alternatives 4 and 5) are relatively easy to repair.

Filling will increase the load on the buried drums and thus creates the potential for collapse of intact drums (if any) that may be in the trench. Drum rupture induced by such loading would be expected to occur quickly, i.e., within a week of the loading. For safety, a period of one month of monitoring after completion of backfill has been included in the short-term groundwater monitoring program to address the possibility of intact drum collapse leading to significant release of chemicals to groundwater. However, drum failure would be more likely to result in slow leakage of liquid (if present). In addition, surrounding soil would provide containment and some adsorption of any released liquid (especially considering the coal content, which will act as an adsorbent similar to activated carbon). Therefore, drum failure would not necessarily lead to groundwater impacts. Collapse of drums would induce surface settlements on the order of only a few inches.

8.1.4 Grading and Surface Water Management

The area to be backfilled and capped (see Section 8.1.5) would be graded to provide proper stormwater drainage. At the present time, runoff from the area surrounding the trench, especially to the southeast, flows into the trench (see Figure 8-3). Thus, trench backfill and grading would decrease the stormwater flow into the trench, and thereby significantly decrease the infiltration even without a cap.

As part of excavating the borrow material for trench backfill, drainage ditches would be constructed at the margins of the cap to intercept surface runoff and convey it away from the trench. These ditches are shown on Figure 8-2. For this FS, the ditches are assumed to be triangular in cross section, 3 feet deep, with 3H:1V side slopes. To minimize cost and maintenance, it is desirable to line the ditches with natural vegetation. Final ditch configurations, locations, and details would be determined using standard hydraulic design methods as part of final design.

8.1.5 Capping

A cap for this site would consist of one or more layers of soil and/or geosynthetic materials installed over the trench backfill. Materials and thicknesses of the candidate caps are shown on Figure 7-1. The area that would be capped is shown on Figure 8-2. This area is based on the areas of suspected waste presence (see Figures 3-6 and Figure 3-15). The cap would extend slightly beyond the trench on both sides to provide anchor zones and "overhang" to reduce the potential for lateral migration of infiltration. Surface water runoff from the cap would be collected in drainage ditches and conveyed off-site.

The major benefit of capping this site would be to reduce infiltration through the waste. Another common benefit of capping, prevention of direct contact and off-site migration in stormwater or dust, is provided by the trench backfill.

The major limitation of a cap is the possibility of damage and the consequent need for inspection and maintenance. The different cap designs have different degrees of vulnerability depending on their components. For example, the low-permeability soil cap would resist settlement better than the FML or FML/GCL caps. If damage did occur, repair of a soil cap would be much easier, requiring only removal of the vegetative soil and adding more low-permeability soil, while repair of the FML or FML/GCL caps would require specialized personnel and equipment.

All cap designs include a top layer of 6 inches of vegetated topsoil to promote evapotranspiration and decrease erosion. This material would be obtained from the area immediately adjacent to the trench. No moisture conditioning is expected, and this soil would not be compacted, in order to provide a loose medium for establishing the vegetative cover. To establish vegetation, the topsoil would be seeded with grasses suitable for the local climate.

8.2 Description Of Remediation Alternatives

8.2.1 Alternative 1: No Action

A "no action" alternative is included as a baseline for comparison to the other alternatives. This alternative would leave the site in its current state, assuming no restrictions on future site use and no site maintenance or monitoring.

8.2.2 Alternative 2: Institutional Controls and Monitoring

This alternative would consist of implementing and maintaining institutional controls as described in Section 8.1.1 and long-term monitoring as described in Section 8.1.2. Institutional controls would prevent direct exposure to waste or affected soil through fencing and site use restrictions. Institutional controls would also prevent use of site groundwater, thereby preventing exposures to constituents of concern if site groundwater were to become affected. Exposure to groundwater could then occur only after off-site migration. If a release were to occur, monitoring would detect constituents of concern in site groundwater prior to off-site migration, which would be followed by appropriate remedial action.

8.2.3 Alternative 4: Soil Cap

This alternative provides a soil cap, as shown on Figure 7-1, over the trench backfill. Because it does not include a low-permeability liner, this cap would not meet the specifications of WAC 173-304. The major steps in this alternative are:

1. Backfill the trench as required for capping (see Section 8.1.3).
2. Allow the backfill to consolidate.
3. Place a soil cap over the trench backfill, including grading and surface water management (see Sections 8.1.4 and 8.1.5).
4. Maintain the cap for 20 years.
5. Implement and maintain institutional controls and monitoring (as described in Sections 8.1.1 and 8.1.2).

The soil cap consists of 18 inches of clean fill soil beneath 6 inches of vegetated topsoil. Cap materials would be obtained from site sources and moisture conditioned. Although the cap soil would be compacted, this cap does not include a permeability specification. It is assumed that the permeability of the soil cap would be greater than the low-permeability soil cap of Alternative 5. This alternative includes regrading and drainage ditches to control surface water as described above.

Installation of this cap could be performed readily using standard earth-moving equipment. A large number of qualified contractors are available. CQA would primarily consist of verifying cap thickness and grading.

Because of its simplicity, little maintenance would be required for this alternative. Any settling after cap installation would be repaired by filling and regrading in the same manner as initial installation. The thickness of the cap would provide long-term protection against erosion.

8.2.4 Alternative 5: Low-Permeability Soil Cap

This alternative provides a low-permeability soil cap, as shown on Figure 7-1, over the trench backfill. The permeability of this soil would be no higher than 10^{-6} cm/sec, and the cap would thus meet MFS specifications in WAC 173-304. The major steps in this alternative are:

1. Backfill the trench as required for capping (see Section 8.1.3).
2. Allow the backfill to consolidate.

3. Place a low-permeability soil cap over the trench backfill, including grading and surface water management (see Sections 8.1.4 and 8.1.5).
4. Maintain the cap for 20 years.
5. Implement and maintain institutional controls and monitoring (as described in Sections 8.1.1 and 8.1.2).

The low-permeability soil cap consists of 24 inches of compacted low-permeability soil beneath 6 inches of vegetated topsoil. For this FS, it is assumed that the spoils at the south end of the trench area near Portal 3 would be suitable. A laboratory permeability test on a single sample (Appendix J) indicated a permeability of about 6×10^{-7} cm/sec. A preliminary field reconnaissance suggests that a sufficient quantity of material is available. The suitability of this or other site sources, in terms of both quality and quantity, would need confirmation during final design. A gravel haul road would be constructed along the existing trail from Portal 3 to trench area 7 to bring soil from the borrow area in the south to the area to be capped in the north. Should site sources not be suitable, the cost of this cap could be greater than the estimates in this FS, in which case the cap design should be reconsidered.

Installation of this cap could be performed readily using standard earth-moving equipment. A large number of qualified contractors are available. CQA would primarily consist of verifying the soil liner meets the permeability specification, as well as verifying cap thickness and grading.

Because of its simplicity, little maintenance would be required for this alternative. Any settling after cap installation would be repaired by filling, compacting, and regrading in the same manner as initial installation. The thickness of the cap would provide long-term protection against erosion.

8.2.5 Alternative 6: FML Cap

This alternative provides a cap with an FML liner, as shown on Figure 7-1, over the trench backfill. By including a synthetic low-permeability liner, the cap would meet MFS specifications in WAC 173-304. The major steps in this alternative are:

1. Backfill the trench as required for capping (see Section 8.1.3).
2. Allow the backfill to consolidate.
3. Place an FML cap over the trench backfill, including grading and surface water management (see Sections 8.1.4 and 8.1.5).
4. Maintain the cap for 20 years.
5. Implement and maintain institutional controls and monitoring (as described in Sections 8.1.1 and 8.1.2).

This alternative consists of a FML overlain by 6 inches of clean fill and 6 inches of vegetated soil. A geotextile would be included below the FML to act as a cushion over the trench backfill and prevent puncturing. The FML thickness is assumed to be 50-mil to comply with the requirements of WAC 173-304.

Installation of this cap requires specialized contractors qualified in FML installation. However, a reasonable number of qualified contractors are available. The most important part of CQA for an FML cap is testing liner integrity after installation. The thickness and quality of the FML would also be subject to CQA, as well as cover soil thickness and grading.

FML is more susceptible to failure on settling than a soil cap. FML is able to stretch in response to settling, but within limits. The detrimental effects of settling on a soil cap are easily repaired by simply replacing the soil. FML settling requires removing and replacing the settled cap section. The repaired area would require careful subgrade preparation to avoid low spots in the liner. New seams, which are a weak point, are created around the repaired area. For this reason, the consolidation period for trench backfill would be critical for this cap design.

FML is not self-sealing against leaks, as is usually the case with soil caps. Thus, inspection and maintenance are more critical than for soil caps. Despite these drawbacks, FML is a common component of landfill caps and would be suitable for this site.

8.2.6 Alternative 7: FML/GCL Cap

This alternative provides a cap with an FML/GCL liner, as shown on Figure 7-1, over the trench backfill. By including two low-permeability liners, the cap would exceed MFS specifications in WAC 173-304. The major steps in this alternative are:

1. Backfill the trench as required for capping (see Section 8.1.3).
2. Allow the backfill to consolidate.
3. Place an FML/GCL cap over the trench backfill, including grading and surface water management (see Sections 8.1.4 and 8.1.5).
4. Maintain the cap for 20 years.
5. Implement and maintain institutional controls and monitoring (as described in Sections 8.1.1 and 8.1.2).

This alternative is similar to the FML cap, except that a GCL is installed in place of the geotextile. Less FML thickness is needed because of the underlying GCL. An FML thickness of 20-mil should be sufficient and is consistent with EPA guidance for a RCRA Subtitle C cap.

Installation of this cap requires specialized contractors qualified in FML installation and also in GCL installation. A limited number of qualified contractors would be available. CQA would be complex, requiring verification of proper installation of both the FML and GCL layers.

Because the GCL is not a thick layer, this cap would be as susceptible to failure due to settling as an FML cap. In the event of cap failure, repair would require removing and replacing the settled cap section. The repaired area would require careful subgrade preparation to avoid low spots in the liner. New seams, which are a weak point, are created around the repaired area. The repair would be more difficult than for FML because two liners would need to be aligned and resealed. For this reason, the consolidation period for trench backfill would be critical for this cap design.

The GCL would add protection against leakage, and GCL would tend to be self-sealing. Inspection and maintenance would be more critical than for soil caps, but less than for the FML cap.

8.2.7 Alternative 9: Excavation and Disposal

This alternative would protect human health and the environment by finding and removing any waste and affected soil from the trench for off-site disposal. The major steps in this alternative are:

1. Excavate the trench and remove all waste and affected soil.
2. Treat excavated material on-site or off-site as required to allow landfill disposal.
3. Haul waste and affected soil for off-site disposal.

Because no waste or affected soil would remain on-site, institutional controls and long-term maintenance and monitoring would not be required for this alternative. This assumes that all waste and affected soil can be located and excavated successfully and that confirmatory monitoring indicates no impacts to groundwater.

Trench backfilling is not included because removal of physical hazards due to an open trench are not a remedial action goal for this site. This alternative would not provide the removal of physical hazards incidental to trench backfilling provided by the capping alternatives.

The nature of contamination and the depth that excavation might be required to be carried to are unknown. It is assumed that excavation to the water table (70 or 80 feet below trench bottom) would be both necessary and sufficient to remove all waste and affected soil. Drums containing some liquid waste are potentially present in the suspected waste areas. Given the quality of site groundwater, it is unlikely that waste or affected soil is present below the water table. However, any waste below the water table would not be found or excavated in this alternative.

There are major concerns with this alternative for worker safety, implementability, and the increased cost to meet these concerns. There is high risk of collapse of the trench bottom (due to voids from mining) and sidewall failure (which has occurred already in some trench sections) as trench material is excavated and destabilizes trench sections. This risk is increased by the suspected presence of subsurface voids masked by sandstone slabs that are believed to exist in the trench (based on interviews with retired mine personnel conducted during the RI). For these reasons, workers or heavy equipment would not be placed in the trench to perform excavation.

Backhoes, loaders, and bulldozers are the most common excavation equipment. However, this equipment could not excavate the trench without operating in the base of the trench. While operations could be conducted using remote controlled equipment, this is atypical, high cost, and not without risk. For example, if voids were encountered, equipment could become jammed in the trench requiring personnel to access the trench bottom. Conventional excavation would require workers entering the trench to reach equipment. Such an activity would be extremely dangerous given the strong potential for trench failure.

A clamshell or dragline could be used to excavate from the top of the trench. However, the long, thin, and steep sides of the trench are not suited to dragline excavation. Furthermore, the rock bridge is the only stable area where a dragline could effectively operate limiting its access to those areas within 40 to 50 feet of the rock bridge. The clamshell is therefore considered to be the safest and most versatile of the available methods for excavating the trench. While much of the near surface materials can be successfully excavated using the clamshell, areas that are below the point at which the trench narrows and starts to follow the dip of the coal seam, may not be recoverable. In addition, as the dip increases, there is considerable potential for jamming the bucket. Thus, it may not be possible to reach all waste and affected soil without unacceptable worker risk.

A clamshell would probably rupture any intact or semi-intact containers in the excavation. Thus, there is a significant potential for excavation to cause release of constituents of concern to groundwater. This risk is much higher (assuming intact drums are present) than the risk of rupture identified for trench backfill prior to capping (see Section 8.1.3). This alternative would bring buried waste and affected soil to the surface for exposure to site workers and the environment; currently this material is protected from exposure. During excavation, the trench would be open to weather and infiltration. Increased exposure to rain could cause migration to the water table of constituents of concern that may be present.

Waste characterization would be performed on stockpiles after excavation. If, as is likely, clean soil is excavated from the trench along with affected soil, this clean soil would be separated to the extent practical. Stockpiles areas would require construction near the trench, congesting trench access. Stockpiling and separation would involve double- or triple-handling excavated material, slowing remedial action and increasing its difficulty and cost.

CQA would be difficult for this alternative. Confirmational soil samples would need to be obtained from the bottom of the trench, and these samples would have to be obtained remotely.

The excavated waste and affected soil would be hauled off-site for disposal. Appropriate disposal facilities would be used, depending on the waste designation (hazardous, dangerous, or non-dangerous). Treatment would be included in this alternative to the extent required to meet land disposal restrictions or other regulatory requirements. The need for treatment has not been established, and the type of any treatment cannot be determined at this time, due to the limited knowledge of constituents that would be encountered. Any required treatment would be performed either on-site or off-site (i.e., at the disposal facility), as determined appropriate at the time the need for treatment were identified based on the type and extent of treatment. If drums of liquid solvent or soil heavily affected by solvent are found, hazardous waste incineration could be required. Soil containing high concentrations of heavy metals could require fixation (chemical stabilization). It is assumed that most waste and affected soil could be landfilled.

Hauling creates risks of injury in traffic accidents and chemical exposure to leaks or spills. Truck traffic carrying waste materials would be significantly increased through a populated area.